

Proposed workplan to address health concerns around SeaTac Airport

August 6, 1998

Prepared by

Washington State Department of Health

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EXECUTIVE SUMMARY

In response to community concerns about health in the SeaTac Airport, Senator Julia Patterson arranged two meetings with community residents, the Washington State Department of Health and other interested parties. As a result of these meetings and preliminary findings of DOH related to rates of glioblastoma in an area approximately 3 miles around SeaTac Airport, Senator Patterson requested that DOH work with the Seattle-King County Department of Public Health (SKCDPH) and the community to develop a workplan to address the community's concerns.

Community representatives presented a list of 18 questions they wanted addressed in the workplan. We (DOH, SKCDPH and a community representative) divided the workplan into two phases. For Phase 1 activities, we recommended steps to be taken to answer the question, who was responsible for doing the work and a timeline for activities. We believe that answers to the questions in Phase 1 will help us determine the value and feasibility of answering the remaining questions. Therefore, for Phase 2 questions, we outlined how Phase 1 activities related to each question and provided some technical information relevant to answering these questions.

Phase One

1. What types of cancer are the most prevalent in the proximity of the airport, and what are their risk factors?

2. Are rates of breast cancer elevated in the proximity of the airport?

To address questions 1 and 2, we recommend analyzing data in the Washington State Cancer Registry for areas approximately 3 and 5 miles around SeaTac Airport to determine what types of cancer are elevated. We recommend preparing a written report of the findings in November 1998.

3. Do we know of all cases of glioblastoma in the proximity of the airport?

4. Can we confirm that all of the suspected cases of glioblastoma have been properly diagnosed as such?

To address questions 3 and 4, we recommend combining information from cancer registries, community reports and medical records to try to identify everyone living or employed in the area around SeaTac Airport. We recommend preparing a written report of the findings in February 1999.

5. Are incidence rates of glioblastoma elevated in the area west of the airport?

We recommend mapping the residences of people with glioblastoma identified through activities for questions 3 and 4. We recommend using geospatial analysis, if appropriate, to determine whether the cases of glioblastoma cluster in the area around SeaTac Airport. We recommend preparing a written report of the findings in March 1999.

6. Is this elevation in glioblastoma incidence rates continuing presently, or did it only occur in the past?

We recommend requesting information from the Cancer Surveillance System of the Fred Hutchinson Cancer Research Center to look at the occurrence of glioblastoma in the area of interest before 1992 and more recent than 1995. We recommend preparing a written report of the findings in December 1999.

7. What are the risk factors for glioblastoma?

We recommend reviewing the epidemiologic, toxicologic, and clinical literature and summarizing the findings in a report by November 1998.

8. What are the chemicals in jet engine exhaust emissions, and what happens to them after they are emitted?

We recommend reviewing the published literature, including reports and environmental impact statements. Unlike question 9, this question is not focused on SeaTac Airport or its airplanes, but rather on airplane engine exhaust emissions in general. We recommend summarizing the findings in a report by January 1999.

9. Is it possible to monitor jet engine exhaust emissions, or to model their path using data on prevailing winds and takeoff patterns?

Before determining the advisability and feasibility of monitoring jet engine exhaust emissions and modeling their path, the workgroup recommends reviewing air monitoring information that has already been collected. We recommend summarizing the findings, including recommendations for further action, in a report by April 1999.

10. Are there other important health problems, such as respiratory disease, in this community, particularly in schools located under the flight path?

We recommend discussions between community residents and SKCDPH to determine whether a health assessment providing information on a standard set of health indicators would address this question. If so, we recommend conducting the health assessment and preparing a report by November 1998. We recommend deferring the question of conducting a community survey until we have the information from question 9.

Phase Two

11. Are similar cases of brain cancer seen near other airports?

We are not optimistic that we can answer this question through a review of the literature. Depending on our findings from Phase 1, we may recommend using other state or national cancer registries to analyze rates of glioblastoma around airports with volumes and topographies similar to SeaTac Airport.

12. Would interviewing family members of people with glioblastoma reveal information that might help determine the cause of the glioblastoma?

Interviewing family members would only be useful to identify residence and occupational history. Information on residence and occupation may lead us to recommend a site visit to determine whether there are unusual activities which might lead to unusual exposures or to recommend an occupational study.

13. Is risk of glioblastoma higher in people who both live in the community and work at the airport?

14. Is risk of glioblastoma higher in people who both live in the community and work in the community, such as teachers?

Depending on the findings for questions 3, 4, and 12, we may recommend a limited study which compares residences and worksites of people with glioblastoma to residences and worksites of people without glioblastoma.

15. Why are incidence rates of glioblastoma elevated in the proximity of the airport?

16. Why are incidence rates of glioblastoma elevated in the Riverton Heights area NE of the airport?

We view these questions as asking, “What is causing glioblastoma in the area around the airport?” For types of cancer where the cause is not known, occupational and laboratory studies have proven to be more successful than community studies for discovering causes. The work for questions 3, 4, 5 and 12 will help us determine whether an occupational study may be useful. Our Phase 1 findings and findings from question 11 (should we pursue question 11) may spur laboratory researchers to conduct research in this area.

17. How are jet engine exhaust emissions related to glioblastoma incidence in general? or around SeaTac Airport? (not clear on question)

To answer this question in general, we may need to expand the review of the toxicology literature (from that proposed in question 8) to determine whether there have been studies in this area. If we can answer questions 3, 4, 5 and 9, we could determine whether there was an association of exposure to jet engine exhaust emissions at SeaTac Airport and glioblastoma. However, we could not conclude that the emissions caused the glioblastoma.

18. Is there a synergistic effect, from smoking and exposure to jet engine exhaust emissions, on the incidence of glioblastoma?

This question is best answered through multicenter epidemiologic studies of glioblastoma or through laboratory studies.

Background

In response to community concerns about health in the community around SeaTac Airport, Senator Julia Patterson arranged a meeting with the Washington State Department of Health (DOH), community representatives and her office. Subsequent to that meeting, DOH analyzed data from the Washington State Cancer Registry (WSCR). The findings revealed elevated rates of glioblastoma in an area approximately 3 miles surrounding the airport. Rates of all types of cancer combined were elevated in the 3 and 5 mile areas around the airport. Rates of gliomas and leukemia were not elevated.

On June 29, 1998, Senator Patterson chaired a meeting with community members, DOH, the Seattle-King County Department of Public Health (SKCDPH), representatives for two King County Council members and a representative from King County International Airport. The community members expressed their concerns and DOH presented the results of their analyses. Senator Patterson requested that DOH work with SKCDPH and the community to develop a workplan to address the community's concerns.

The committee developing the plan included:

Washington State Department of Health

Juliet VanEenwyk, PhD, Epidemiologist, Office of Epidemiology (Chair)

Steven Macdonald, PhD, Epidemiologist, Office of Epidemiology

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Community Representative

Anne Hunt, MD, neurologist and community resident

Prior to developing a workplan, the committee submitted a written list of concerns to community participants at the June 29th meeting to assure that we had captured the concerns accurately.

We divided the workplan into two phases. For Phase 1 activities, we recommended steps to be taken to answer the question, who was responsible for doing the work and a timeline for activities. We believe that answers to the questions in Phase 1 will help us determine the value and feasibility of answering the remaining questions. Therefore, for Phase 2 questions, we outlined how Phase 1 activities relate to each question and we provided some technical information relevant to answering these questions. We will revisit Phase 2 questions when we complete Phase 1.

Phase One

Questions One – Six: Descriptive Epidemiology

- 1. What types of cancer are the most prevalent in the proximity of the airport, and what are their risk factors?**
- 2. Are rates of breast cancer elevated in the proximity of the airport?**

Proposed Workplan

1. Replicate the DOH analysis described in the first paragraph of the background section, looking at the 10 most commonly diagnosed cancers in Washington State. (Areas 1 and 3 only, include 1996 data.)
2. If we find meaningful elevations for a specific cancer site, look at subtypes of that cancer, demographics of those with the cancer, and distribution by year of diagnosis.
3. Review the literature to determine risk factors for cancers that are elevated around SeaTac Airport.

All cancer is a combination of different diseases involving many different risk factors. Through this analysis we should be able to discover whether specific types of cancer are responsible for the higher than expected amount of “all cancer” around SeaTac Airport. We will also know whether the amount of breast cancer is higher than in the rest of Washington.

Lead: DOH Office of Epidemiology
Collaborators: DOH Washington State Cancer Registry Program
SKCDPH, Epidemiology, Planning and Evaluation Unit

Anticipated Timeline

Conduct analyses: September 1998
Data interpretation: October 1998
Prepare report: November 1998

- 3. Do we know of all cases of glioblastoma in the proximity of the airport?**
- 4. Can we confirm that all of the suspected cases of glioblastoma have been properly diagnosed as such?**

Proposed Workplan

1. Develop case definition by determining
 - area of interest (The workgroup recommends 3 miles around the airport security boundary.);
 - time period of interest;
 - residency and/or employment requirements (The workgroup recommends residency or employment in the 3-mile area at time of diagnosis. If the definition is broader, we recommend relying on community reports to find cases.);
 - diagnoses of interest (The workgroup recommends glioblastoma as a primary tumor only. We need to be clear on the differential diagnosis of glioblastoma, as different sources provide different definitions).

2. Develop a preliminary list of people who meet the case definition by combining information from the Washington State Cancer Registry, the Fred Hutchinson Cancer Registry (if possible and necessary) and reports from the community. For people employed in the area of interest, we will rely on reports from the community. At a later stage, we may recommend more active case-finding related to employment.
 - DOH will provide community representatives with forms on which to submit information.
3. Confirm diagnosis and date of diagnosis.
 - The list of names from the community will be matched with the cancer registries. If the registry indicates glioblastoma as the primary type of cancer, we will accept the diagnosis as confirmed.
 - We will conduct a review of medical records for people who are not listed in the registries to confirm diagnosis.
4. Determine residency. (If the case definition includes only people who are residents at time of diagnosis, we can obtain address at diagnosis through the registries and medical records. Reports of people with glioblastoma outside the SeaTac Airport area at time of diagnosis will come from the community and we will rely on community reports for residency information. Since all reports of people working within a 3-mile radius of SeaTac Airport will come from the community, we can determine clusters by worksite from community reports.)

Lead: DOH Office of Epidemiology
 Collaborators: Community Residents
 DOH Washington State Cancer Registry Programs
 FHCRC Cancer Surveillance System
 SKCDPH, Epidemiology, Planning and Evaluation Unit
 Dr. Hunt
 Expert(s) to review medical records

Anticipated Timeline

Determine case definition: August 1998
 Community submits list of names to DOH: September 1998
 Link to WSCR and FHCRC: October- November 1998
 Records review: December 1998 - January 1999
 Prepare report: February 1999

5. Are incidence rates of glioblastoma elevated in the area west of the airport?

Proposed Workplan

1. Map cases of glioblastoma identified through the process outlined for questions 3 and 4.
2. Investigate geospatial analysis techniques.
3. Conduct analysis.

Lead: DOH Office of Epidemiology
 Collaborators: SKCDPH, Epidemiology, Planning and Evaluation Unit
 University of Washington

Anticipated Timeline

Investigate geospatial analysis techniques: September – November 1998

Map residence (or workplace?) at diagnosis: January 1999
Conduct analysis: February 1999
Prepare report: March 1999

6. Is this elevation in glioblastoma incidence rates continuing presently, or did it only occur in the past?

Proposed Workplan

1. Request file from FHCRC containing the age, sex and zipcode for people diagnosed with glioblastoma for the six zip codes comprising a 3 mile radius around SeaTac Airport. (FHCRC has cancer incidence data from the early 1970s. We will request the earliest year of reliable data for which zip code was also collected. Because zip codes may change over time, we may need to identify the relevant zip codes in the earlier time periods.)
2. Combine the information from FHCRC with that from WSCR to look at the number of cases of glioblastoma per year.
3. If necessary, compare the observed to the expected number.

Lead: DOH Office of Epidemiology
Collaborators: DOH Washington State Cancer Registry programs
FHCRC Cancer Surveillance System
SKCDPH, Epidemiology, Planning and Evaluation Unit

Anticipated Timeline

Send written request to FHCRC: August 1998
Receive data file from FHCRC: October 1998
Develop data from WSCR: October 1998
Conduct analysis: November 1998
Prepare report: December 1998

Questions Seven and Eight: Literature Review

7. What are the risk factors for glioblastoma?

Proposed Workplan

1. Review the epidemiologic, toxicologic, and clinical literature by reviewing “secondary literature” (published reviews and textbooks) and computer searches for more recently published research reports.
2. Develop summary statements of the findings classifying risk factors as confirmed, probable, possible or suspected, and studied, but not a risk factor.

Leads: SKCDPH Epidemiology, Planning and Evaluation Unit for review of
epidemiology literature
DOH Office of Environmental Health Assessment Services for review of
toxicology literature
Dr. Anne Hunt for review of clinical literature
Collaborators: DOH Office of Epidemiology

Anticipated Timeline

Prepare report: November 1998.

8. What are the chemicals in jet engine exhaust emissions, and what happens to them after they are emitted?

1. Review published literature, including reports and environmental impact statements. Unlike question 9, this question is not focused on SeaTac Airport or its airplanes, but rather on airplane engine exhaust emissions in general.
2. Prepare a report.

Lead: DOH Office of Environmental Health Assessment Services

Anticipated Timeline

Report: January 1999.

Questions Nine and Ten: Potential Field Studies

9. Is it possible to monitor jet engine exhaust emissions, or to model their path using data on prevailing winds and takeoff patterns?

Proposed Workplan

Before determining the advisability and feasibility of monitoring jet engine exhaust emissions and modeling their path, the workgroup recommends reviewing air monitoring information that has already been collected.

1. Convene a workgroup to determine what information is available.
2. Collect available information.
3. Review available information and determine end points for risk assessment.
4. Assess risk from exposure to pollutants identified in previous step.
5. Combine this information with information from question 8 to determine whether additional monitoring is necessary to assess risk of living near airport due to air quality.
6. If monitoring is recommended, determine technical feasibility and cost.
7. Prepare report on findings and recommendations

Lead: DOH Office of Environmental Health Assessment Services
Collaborators: Department of Ecology
University of Washington
SKCDPH Environmental Health
Port of Seattle
Puget Sound Air Pollution Control Authority

Anticipated Timeline

Convene workgroup: October 1998
Identify and obtain previously collected air monitoring data: November 1998
Review information and determine end points for risk assessment: December 1998
Conduct risk assessment: February 1999
Develop recommendations: March 1999
Prepare report: April 1999

10. Are there other important health problems, such as respiratory disease, in this community, particularly in schools located under the flight path?

The workgroup viewed this question as asking “Is living near the airport a problem in terms of health?” In theory, this question can be addressed by looking at previously collected data (such as mortality and hospitalization data) or a field study involving surveys of community residents.

1. Previously collected data: The SKCDPH conducts standard health assessments that describe the health of a community according to a standard set of health indicators. Many communities find this information useful for identifying needs for public health programs. However, our experience has been that communities concerned about environmental exposures may not find the information contained in the standard health assessment useful.

Proposed Workplan

1. Discuss with community representatives the desirability of conducting a standard health assessment for the area approximately 3 miles around SeaTac Airport.
2. If community members believe a standard community health assessment will help answer question 10, conduct the assessment.

Lead: SKCDPH Epidemiology, Planning and Evaluation Unit
Collaborators: Community representatives
DOH Office of Epidemiology

Anticipated Timeline

Decision on usefulness of standard community health assessment: September 1998
Conduct standard health assessment: October 1998
Prepare report: November 1998.

2. Field study: It is difficult to answer the question “Is living near the airport a problem in terms of health?” without knowing the pollutants related to the airport, including direct airport activities (such as jet engine exhaust emissions) and indirect activities (such as traffic congestion and associated motor vehicle exhaust emissions). Thus, for example, if we conducted a field study and found elevated rates of respiratory disease among school children, we would not be able to

definitively link the problem to activities related to the airport. In our experience, scientifically valid community studies are resource intensive and often do not yield definitive results.

1. Reassess the usefulness of conducting a field study based on information developed in answering question 9.
2. If useful, narrow the focus of the study, assess feasibility and cost, and determine roles for agencies and the community.
3. If feasible and affordable, conduct study.

Lead (for assessing usefulness):

DOH Office of Epidemiology

Collaborators:

SKCDPH Epidemiology, Planning and Evaluation Unit

Community representatives

University of Washington

Anticipated Timeline

Decision on usefulness of field study: May 1999

Phase Two

Question 11: Descriptive Epidemiology

11. Are similar cases of brain cancer seen near other airports?

In our initial review of reviewed the scientific literature on health around airports, we identified only one study that reported rates of cancer for people living around an airport (Schiphol) compared to people living in the rest of the country (Netherlands). The abstract for this study (full study not in English) does not identify brain cancer as elevated around the airport. However, it is doubtful that the researchers looked specifically at glioblastoma. Another study looked at deaths from childhood cancer and identified airfields as one of many potential environmental hazards related to cancer. However, this study does not discuss different types of cancer separately and does not control for other potential risk factors. Thus, it does not appear that this question of whether similar cases of brain cancer are seen near other airports can be answered by a review of the literature, although we will not be sure of this until we complete question 7.

One approach is to identify airports in the United States with similar topographies and adjacent residential areas to determine whether there are elevations in glioblastoma around those airports. This activity requires the cooperation of cancer registries in other states. Activities completed in Phase 1 will help us to determine whether we have sufficient scientific evidence to make a compelling case for other states to take on this work. The Phase 1 activities will also help us define more precisely how we recommend other states conduct the analyses. Phase 1 work may also help us to engage federal agencies (such as Centers for Disease Control and Prevention [CDC] National Center for Environmental Health [NCEH] and the Agency for Toxic Substances and Disease Registry [ATSDR]) to help with this work. Therefore, we recommend reconsidering this activity at the end of Phase 1 (April 1999).

Questions Twelve - Sixteen: Etiologic Studies

12. Would interviewing family members of people with glioblastoma reveal information that might help determine the cause of the glioblastoma?

In our experience, we will not be able to answer this question definitively. We can develop hypotheses by understanding where the people lived and worked. Once we know that information, we can hypothesize whether there are potential common exposures among those with glioblastoma. However, to determine whether these exposures are causing the glioblastoma, we would need to know that the exposures are not present in other communities where glioblastoma rates are normal. (See questions 15 and 16.)

If we need to interview people with glioblastoma or family members to determine residency to answer questions 3 – 5, it would be efficient to ask about occupation at the same time. If we do not need to interview community residents to answer the Phase 1 questions, we will determine the usefulness of conducting interviews when phase 1 activities are completed. (March 1999)

Many questions that will arise in connection to the cause of the glioblastoma in the SeaTac area cannot be answered by this type of interview. For example, we know nothing about the quality of drinking water of people who developed glioblastoma. In our judgment, we cannot reconstruct that information for the time periods of interest unless we assume that the water quality today is the same as in the past. We do not think that is a valid assumption. We also do not know the time period of interest. Many types of cancer take years to develop. This is called the "latency period" and we do not know the latency period for glioblastoma.

Therefore, if we proceed with interviewing community residents, it will be only to answer the questions of where people lived in a specified period of time before diagnosis and to determine whether there were common workplaces. If many people lived in a relatively small area within the 3 mile radius of SeaTac Airport, we might recommend a site visit to determine whether there are any unusual potential exposures in that area. We might also be able to use information collected in question 9 to answer questions about air quality in a small area. If the people with glioblastoma had common workplaces, we may recommend an occupational study.

13. Is risk of glioblastoma higher in people who both live in the community and work at the airport?

14. Is risk of glioblastoma higher in people who both live in the community and work in the community, such as teachers?

These questions build on answers to questions 3, 4, and 12. While several cancers among people who live close to one another may be a lot for a small community, most community studies of cancer clusters are limited because there are not enough people with cancer to conduct a scientifically valid study. If we identify common workplaces among people with glioblastoma and there are a sufficient number of cases at any one worksites, in theory, we could conduct a case-control study to determine whether risk of glioblastoma is higher for people working at a particular location. Preliminary calculations for the number of total cases and estimated proportions at a given workplace follow. We would need to recalculate these figures once we obtained the answers to question 12. If a case-control study were possible based on numbers, we would need to discuss feasibility in terms of resources and projected benefit.

Parameters: Confidence Level: 95%

Power:	80%				
Cases/Controls:	1/3				
		Proportion employed		Number of participants	
		cases	controls	cases	controls
Teachers		15%	0.05%	32	96
		10%	0.10%	51	153
Airport Workers		40%	10.00%	23	69
		20%	5.00%	52	156

15. Why are incidence rates of glioblastoma elevated in the proximity of the airport?

16. Why are incidence rates of glioblastoma elevated in the Riverton Heights area NE of the airport?

We view these questions as asking, “What is causing glioblastoma in the area around the airport?” There are many approaches to discovering the cause of a cancer. If there are known risk factors for the cancer, we look in the community to see whether we can find the cause and get rid of it. For example, if we had a cluster of mesothelioma (a type of lung cancer), we would look in the community to see whether there was asbestos. If we found asbestos, we would remove it. For types of cancer where the cause is not known, occupational and laboratory studies have proven to be more successful than community studies for discovering causes. The work for questions 3, 4, 5 and 12 will help us determine whether an occupational study may be useful. Our Phase 1 findings and findings from question 11 (should we pursue question 11) may spur laboratory researchers to conduct research in this area.

Community studies of cancer clusters are usually unable to answer questions of what has caused the disease. We do not recommend a community study to try to discover why there are elevations in glioblastoma around the airport. There are several important reasons why these types of studies do not find answers.

- While the number of cases may be high for the community, the numbers are not large enough to find risk factors responsible for relatively small increases in risk, such as risk factors which double or triple the risk. In the sample numbers presented for questions 12 and 13, the smallest detectable increase in risk is a 5-fold increase.
- When we do not know risk factors for disease, we may ask many questions and still not include the correct questions.
- When we do not know the natural history of the disease, we do not know what time period is most important. If an environmental exposures causes glioblastoma, we do not know how long it takes to develop glioblastoma after exposure (i.e., we do not know the latency period). For cancers where we do know some of the causes, the latency periods are between several years (e.g., leukemia after exposure to ionizing radiation) to several decades (e.g., smoking and lung cancer). Because we do not know the latency period for glioblastoma, we do not know how long before diagnosis to look for exposures. Therefore, if we ask questions about several years before diagnosis, we may miss the time period of interest.

- People often cannot report what they are exposed to through work, their home environment and their hobbies or other activities, because they may not know. For example, until about 10 years ago, people were not aware that many home products (e.g., carpeting, particle board) emitted formaldehyde, a possible human carcinogen.
- Obtaining accurate information becomes more difficult when we ask about events from several or more years ago and when we ask families of people with disease. Because glioblastoma is usually rapidly fatal, we would need to ask questions of family members. Because we do not know the latency period, we may need to ask about events long before exposure.
- We usually cannot reconstruct exposure histories from many years ago. Contaminants in the home or workplace and in the air and water change over time. Measuring contaminants in the air and water today, does not give us an indication of what was in the air and water several years ago.
- The strength of epidemiologic evidence comes from consistency among many similar studies combined with basic science which discovers the biological plausibility for the epidemiologic associations. One epidemiologic study cannot provide definitive answers.

Questions 17 and 18: Miscellaneous

17. How are jet engine exhaust emissions related to glioblastoma incidence in general? or around SeaTac Airport? (not clear on question)

Our review of the epidemiologic literature to date, has not indicated that jet engine emissions are related to glioblastoma. However, it is not clear whether this topic has been studied. The review of the toxicology literature in question 8 may provide some answer as to whether jet fuel emissions have been studied in relation to glioblastoma. To answer this question in general, we may need to expand the review of the toxicology literature (from that proposed in question 8) to determine whether there have been studies in this area.

If we can answer questions 3, 4, 5 and 9, we could determine whether there was an association of exposure to jet engine exhaust emissions at SeaTac Airport and glioblastoma. However, we could not conclude that current emissions cause glioblastoma. There may be something else which is associated with current emissions (such as something that used to be in jet emissions which is no longer present or pollutants from sources other than jet engines) that actually caused the glioblastoma. Additionally, we would need to assume that conditions present today have been constant for many years, since many of the people with glioblastoma were diagnosed in the early 1990s. Finally, one study cannot provide definitive answers. We would need additional epidemiologic and laboratory studies before we could conclude that the jet engine exhaust emissions caused glioblastoma. The answers to the literature review discussed in the preceding paragraph and to question 11 might provide some insight for the interpretation of finding a relationship between jet engine exhaust emissions at SeaTac Airport and cases of glioblastoma.

18. Is there a synergistic effect, from smoking and exposure to jet engine exhaust emissions, on the incidence of glioblastoma?

This question is best addressed through multicenter epidemiologic studies of glioblastoma or through laboratory studies. Researchers generally look for synergistic effects among known risk factors. Neither smoking nor exposure to jet fuel are known risk factors for glioblastoma. To our knowledge, this question has not been researched. Consideration presented for questions 15 and 16 are relevant to this question.